Sealant and Bondo Compatibility with Eight Candidate HPACS Coating Systems

Background:

Air Force Research Laboratory conducted a study in 1994-1996 to determine if the commercial paint industry had indeed developed better coating systems as they had stated several times to Air Force personnel. The Coatings Technology Integration Office (CTIO) is charged with identifying coating systems for military aircraft that are environmentally compliant and have enhanced performance. Paint manufacturers were solicited to submit production or development candidate systems meeting the above requirements without regard to the military specifications governing aircraft coatings. The High Performance Aerospace Coating Systems (HPACS) initiative is focused on accelerating the evaluation and acceptance of environmentally compliant, enhanced performance coating systems for near term integration into the USAF aircraft refinishing operations. The coating systems range from conventional epoxy primers with solvent-based urethane topcoats to non-chromated epoxy primers and waterborne urethane topcoats.

Project Sponsor/Customer: Air Force wide
Period of Performance: 1995 -1997

Objective:

As part of the HPACS evaluation, this project focused on evaluating the sealant and bondo compatibility of the eight candidate coating systems. The governing authority for the evaluation is the Coating System Requirements Document (CSRD). The CSRD specifies sealant and bondo compatibility shall meet the requirements specified in the National Aerospace Standard (NAS) 1534. The specification for Standard Conditions is altered by the CSRD from the standard stated in NAS 1534 to temperatures between 60° to 90° F with a corresponding relative humidity between 30 and 80%. The NAS classification specification NAS 1534 addresses the overall requirements for low Volatile Organic Compounds (VOC), chemical and solvent resistant primer coatings that are formulated primarily for application by various spray techniques. The specifications for sealant compatibility testing are a small fraction of the total specification contained in the standard.

Status:

When a coating system is proposed for aircraft applications, the manufacturer usually has data upon which expectations are based. Data may be adhesion strength, erosion resistance, gloss retention, etc., but this data is usually constrained to the coating system applied to aluminum and possibly some composite materials. However, many aircraft have numerous sealant and structural adhesive materials. The performance of a coating when applied to these sealants and adhesive materials cannot always be predicted. Although the exposed painted surface areas of the sealants and adhesives are localized, their presence on the painted surface is abundant and distributed. Localized failure of the coating system in these areas could require repainting of the aircraft.

Poor performance of a coating system when applied to sealant and adhesives can be caused by chemical incompatibility or characteristic surface phenomena. Chemical incompatibility between the sealant and coating system primer can induce a loss of either adhesive or cohesive strength. Material strengths can be greatly affected by leaching of very small concentrations of contaminants from one material system and subsequent migration of the contaminants to the material interface or into the second material. The characteristic surfaces of some sealant materials readily bond with some materials but not with others. Incompatibility in characteristic surface phenomena results in a reduction in the adhesive strength between the material systems.

A specific application where sealant compatibility is critical is the sealing in and around the fuel tanks of aircraft. A specific test has been developed to judge the compatibility of fuel tank sealants with coating system primers. The test is conducted by applying a candidate primer to a test panel and subsequently curing the primer under prescribed conditions. A strip of reinforcing material is incorporated into the middle of the sealant material during its application to facilitate peeling the sealant material from the test panel during the peel test. The peel test is conducted in a similar manner to peeling a piece of Scotch tape from the surface of a desk. The force per unit width required to peel the sealant form the test panel is measured and recorded along with estimates of the relative amounts of adhesive and cohesive failure. Minimum values of these diagnostics are required to pass the test.

The results of tests, conducted in strict adherence with NAS 1534, indicate only two of the eight coating systems pass the minimum requirements. Although the validity of the

standard is questionable, the test results presented are valid for NAS 1534. Trends in test data indicate a correlation may exist between the loss of average peel strength with the loss of average cohesive failure strength. A possible cause for the loss of average cohesive failure strength is inadequate curing of the sealant material.

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